

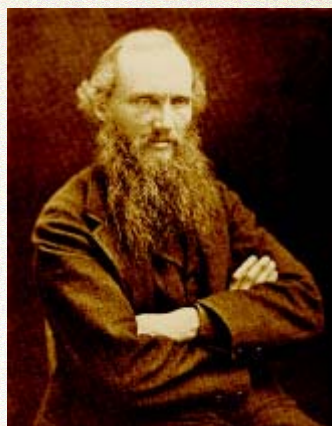
# Innovation at Intel

January 2005



# **Innovation** is not for the **faint hearted**





"Heavier-than-air flying machines are impossible"

Lord Kelvin  
Royal Society of London  
June 1885

$$\Gamma = \int_C \underline{U} \cdot d\underline{M}$$

$$\dot{\Gamma} = \frac{d}{dt} \int_C \underline{U} \cdot d\underline{M} = \int_C \left( \frac{d\underline{U}}{dt} + \underline{U} \cdot \underline{\text{grad}} \underline{U} \right) \cdot d\underline{M}$$

$$\dot{\Gamma} = \int_C \underline{\gamma} \cdot d\underline{M} + \int_C \underline{U} \cdot d\underline{U}$$

$$\dot{\Gamma} = \int_C \underline{\gamma} \cdot d\underline{M}$$

$$\underline{\gamma} = -\frac{1}{\rho} \underline{\text{grad}} p - \underline{\text{grad}} V$$

$$P(p) = \int \frac{dp}{\rho(p)}$$

$$\underline{\text{grad}} \Gamma = \frac{1}{\rho} \underline{\text{grad}} p$$



"A Man-carrying airplane will eventually be built, but only if engineers work steadily for the next one to ten million years"

New York Times, October 1903,  
8 weeks before the Kitty Hawk Flight

**HOUSEHOLD FURNITURE**  
In Furniture, we carry full lines of the best and most reliable makes of Suits, Chiffoniers, Sideboards, Chairs, Kitchen Cabinets, Mattresses, Springs, Etc.

**STOVES**  
In Stoves, we have the Thomas White combination Gas and Coal Heaters and Cook Stoves. Adler & Palacelone of Gas Heaters.

**Carpets, Rugs and Art Squares.** All wool—"Union" and the extra quality double-faced "Deklan" Rugs.

**CURTAINS**  
Thinware, Graniteware, Gas Lamps, Earthenware, in fact everything for the house.

**Miller & Dack**  
Telephone No. 375 211 West Main Street

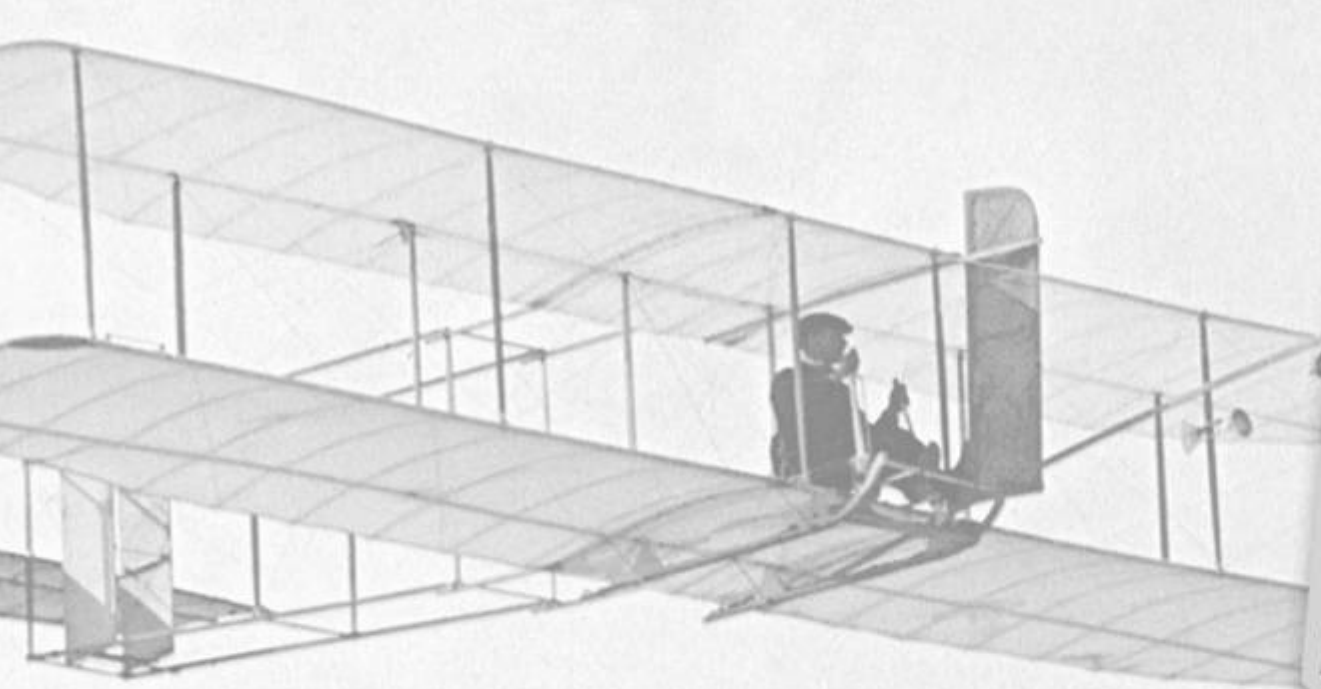
**We Have 'Em**

**Will Give It Away**  
New York, Nov. 11.—Mr. Hessel Sage will give away the bulk of the fortune of about \$80,000,000, bequeathed to her by her late husband, to individuals whom she considers worthy.

**Phone No. 57**

**Intel Technology Research**





possible  
possible

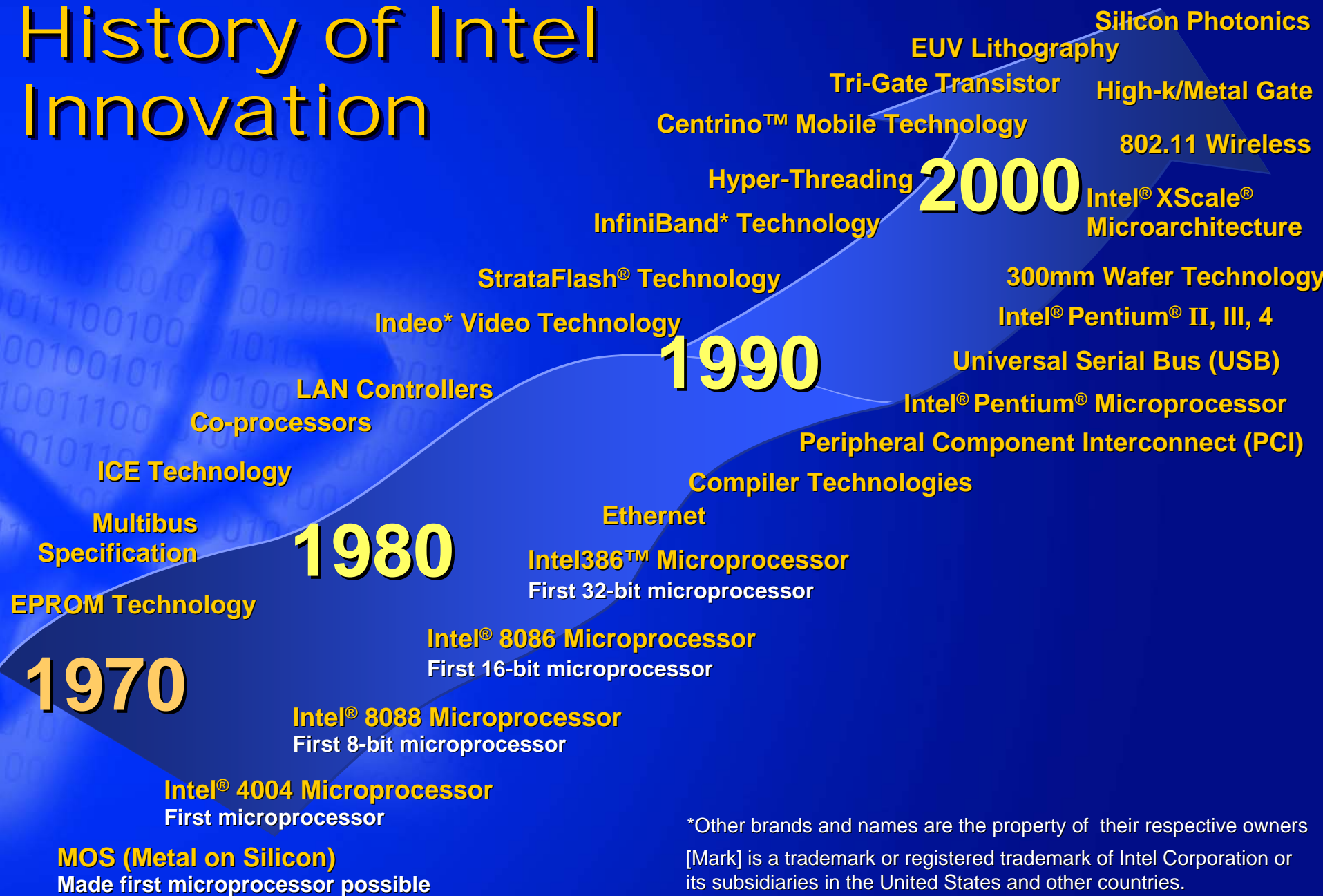
" The Wright Brothers flew right through  
the smokescreen of impossibility."

*-Charles Kettering*

# Today Innovation Happens...

**inquisitive minds,  
perseverance,  
enabling environment,  
and investment  
in Research Globally**

# History of Intel Innovation



\*Other brands and names are the property of their respective owners  
[Mark] is a trademark or registered trademark of Intel Corporation or its subsidiaries in the United States and other countries.

# Today...

## Intel is a Top Global Innovator

9800+ issued U.S. patents

1602 U.S. patents in 2004

12000+ in the pipeline

Inventors citizens of 92 different countries

## With a Diverse Portfolio

Silicon technology and microprocessor research

Proactive computing

Communications

Ethnography/social sciences

Life sciences

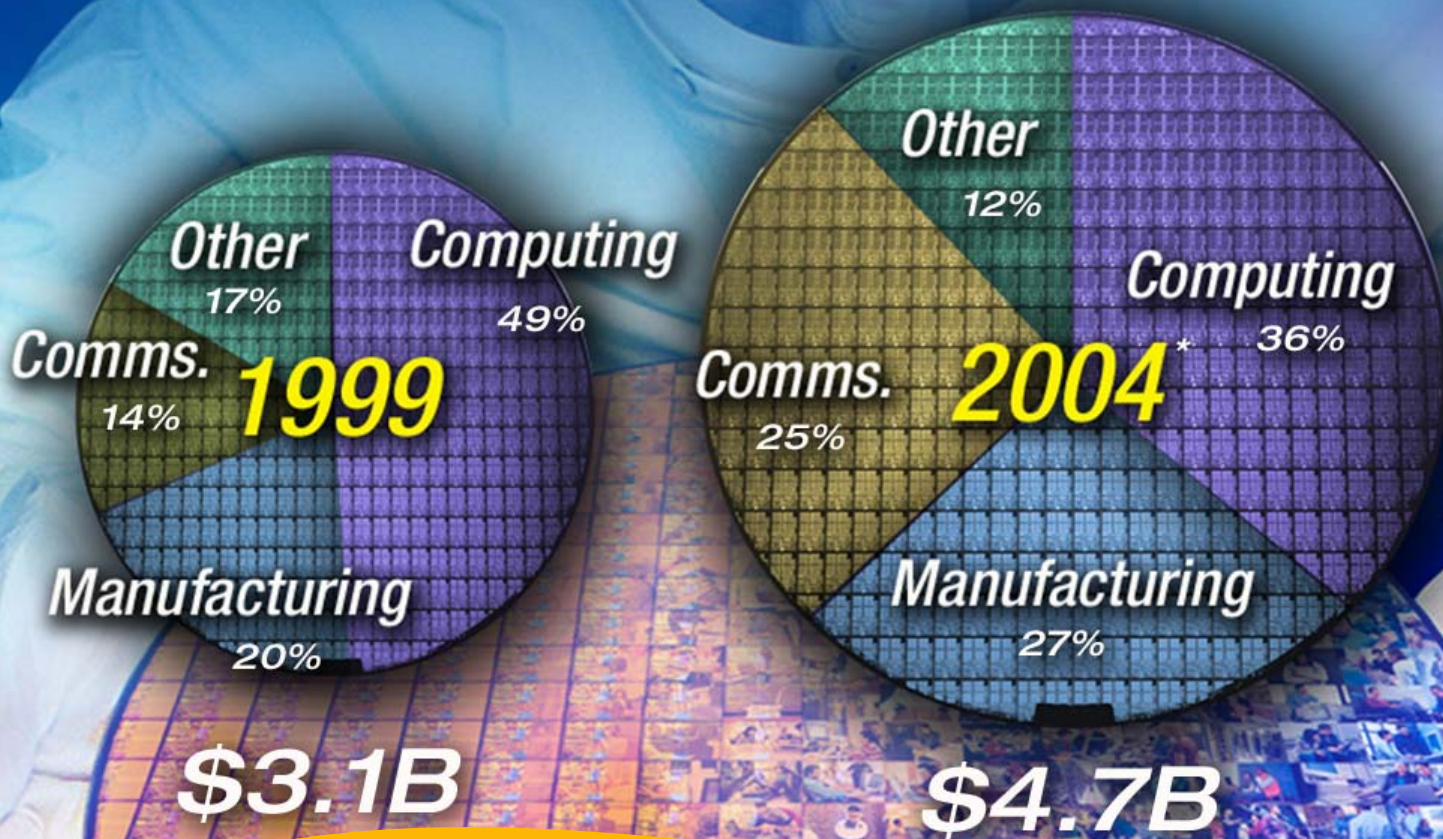
... and many more

***Ranked among the elite Top 10 global companies for U.S. patents issued in 2004***



# Portfolio of Innovation

## Investing in Technology and Research



\*Forecast

**75 Labs Worldwide**

**7500 R&D Personnel**

**1602 U.S. Patents in 2004 – Among the Top 10**

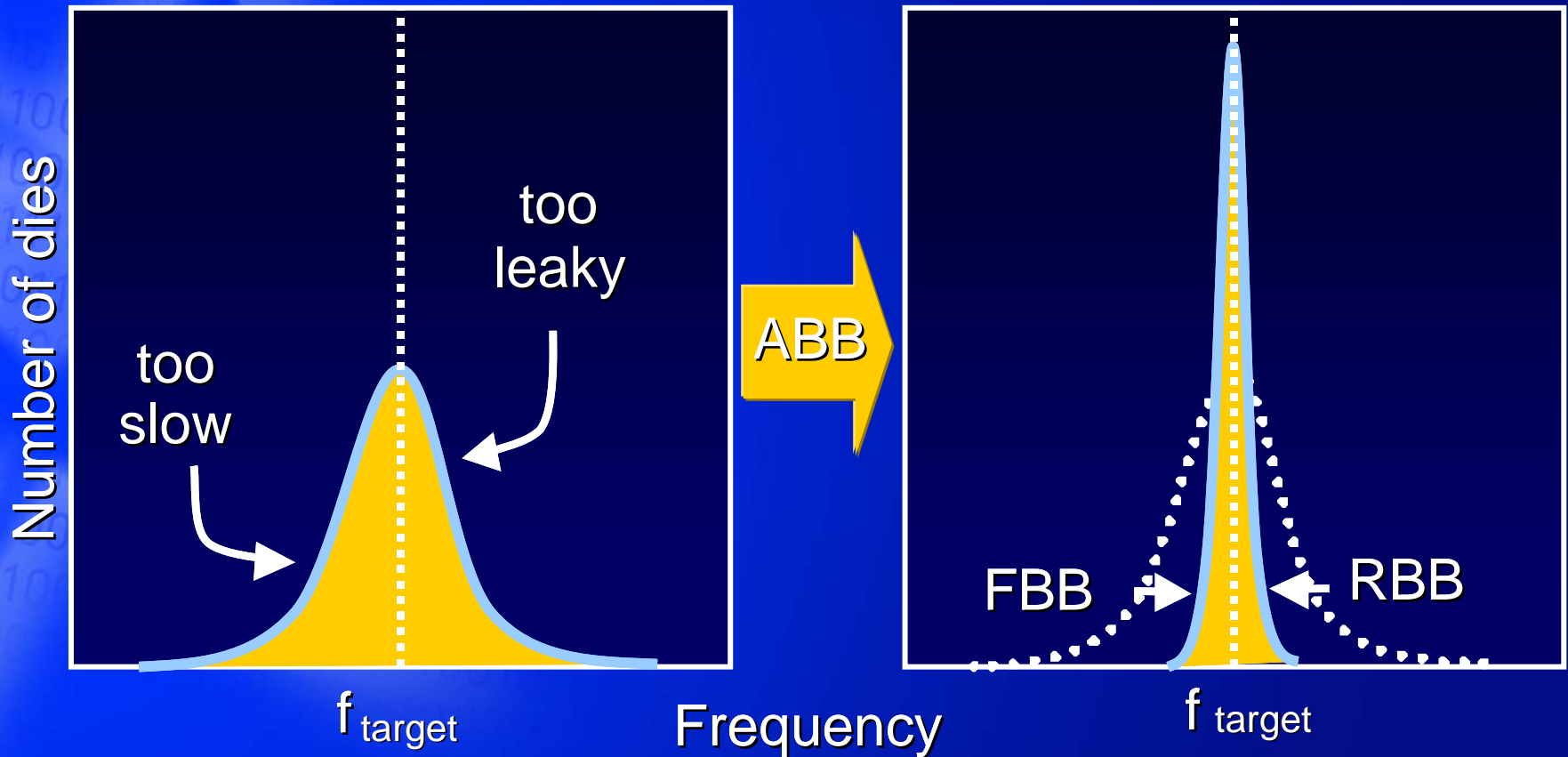
[www.intel.com/technology](http://www.intel.com/technology)



# A Glimpse...

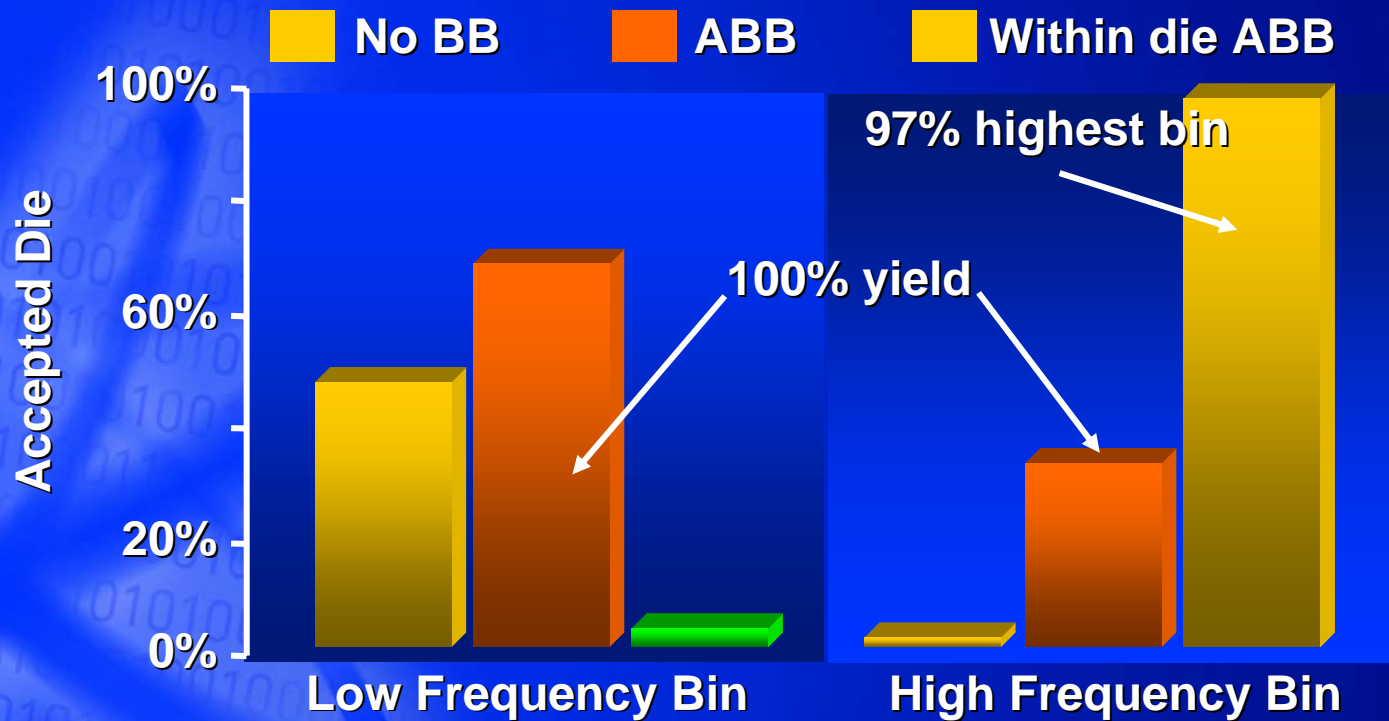
Patent #6,448,840

## Adaptive Body Biasing



# Adaptive Body Biasing

Patent #6,448,840



**100% yield with Adaptive Body Biasing**

**97% highest freq bin with ABB for within die variability**

# Expanding the Value of CMOS Silicon Technology

Patent No.	Title	Description
6,771,174	Digital Pill Box	Relates to tracking a patient's usage of medicine using a computerized pillbox
6,717,567	Wireless Digital Picture Display Frame	Relates to wireless picture frame for displaying pictures transmitted remotely
6,812,810	Bridges for Electromechanical Structures (MEMS)	Bridges air gaps in micro-electromechanical structures
6,806,543	Microfluidic Apparatus with Integrated Porous Substrate/Sensor for Real-Time (Bio)Chemical Molecule Detection	Relates to using porous device for sensing or detecting of bio-related molecules
6,782,249	Quadrature Signal Generation in an Integrated Direct Conversion Radio Receiver	Relates to receiver for direction conversion of RF signals



# A Glimpse ...

## Digital Pill Box

Patent #6,771,174



Pill Box



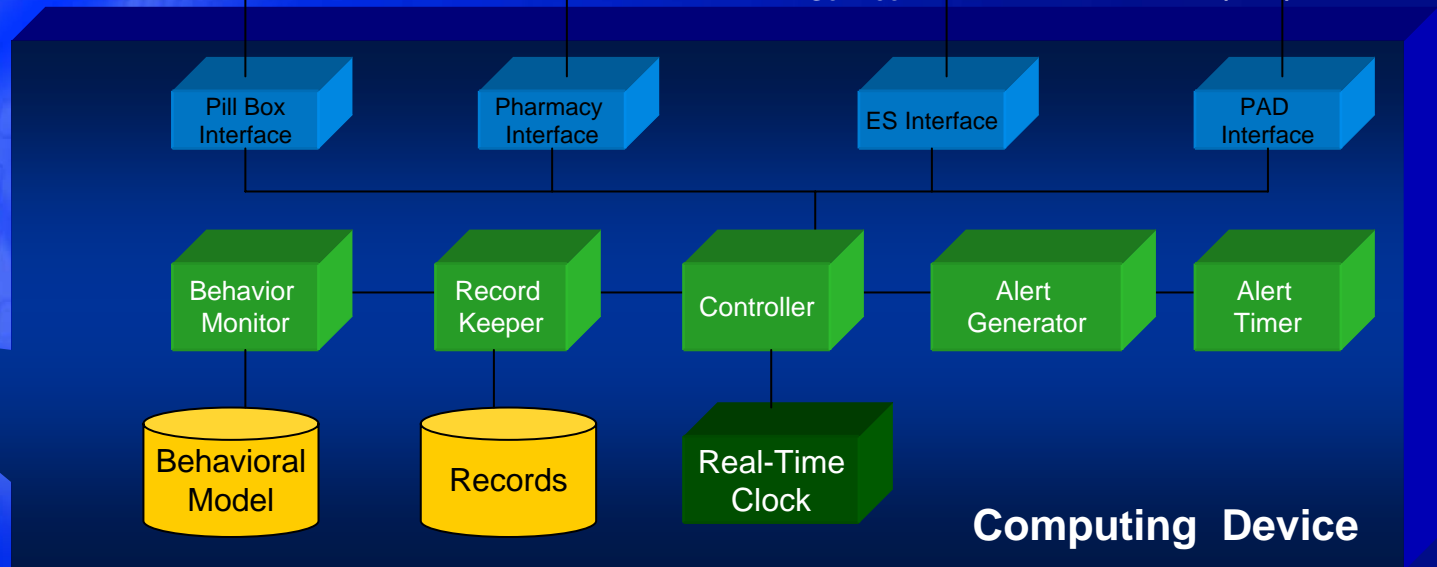
Pharmacy



Emergency  
Service



Personal Alarm  
Device (PAD)

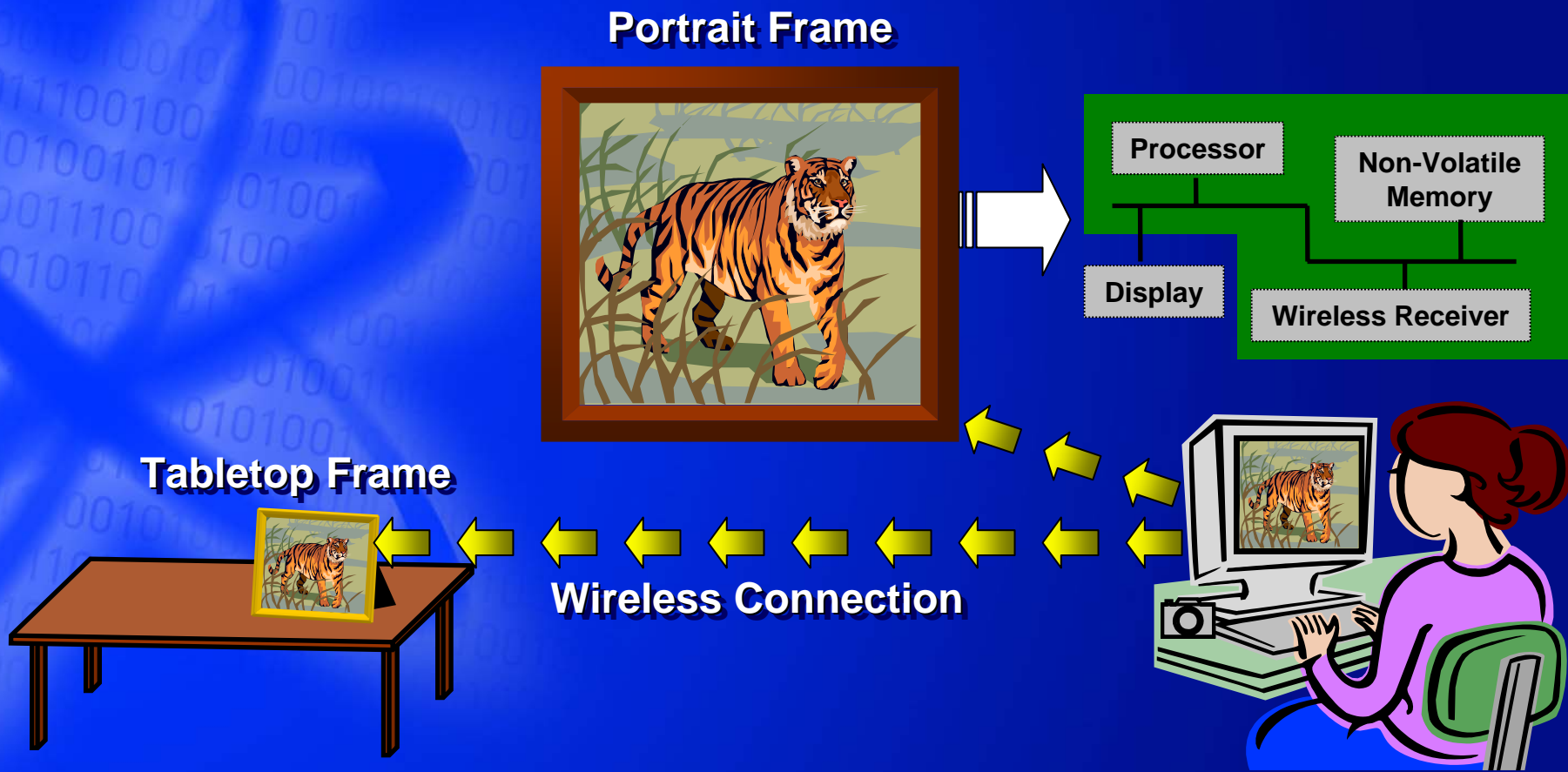


A digital pill box, personal alert device, and a computer-implemented system aids patients in maintaining a desirable dosage schedule of medicines

# A Glimpse ...

Patent #6,717,567

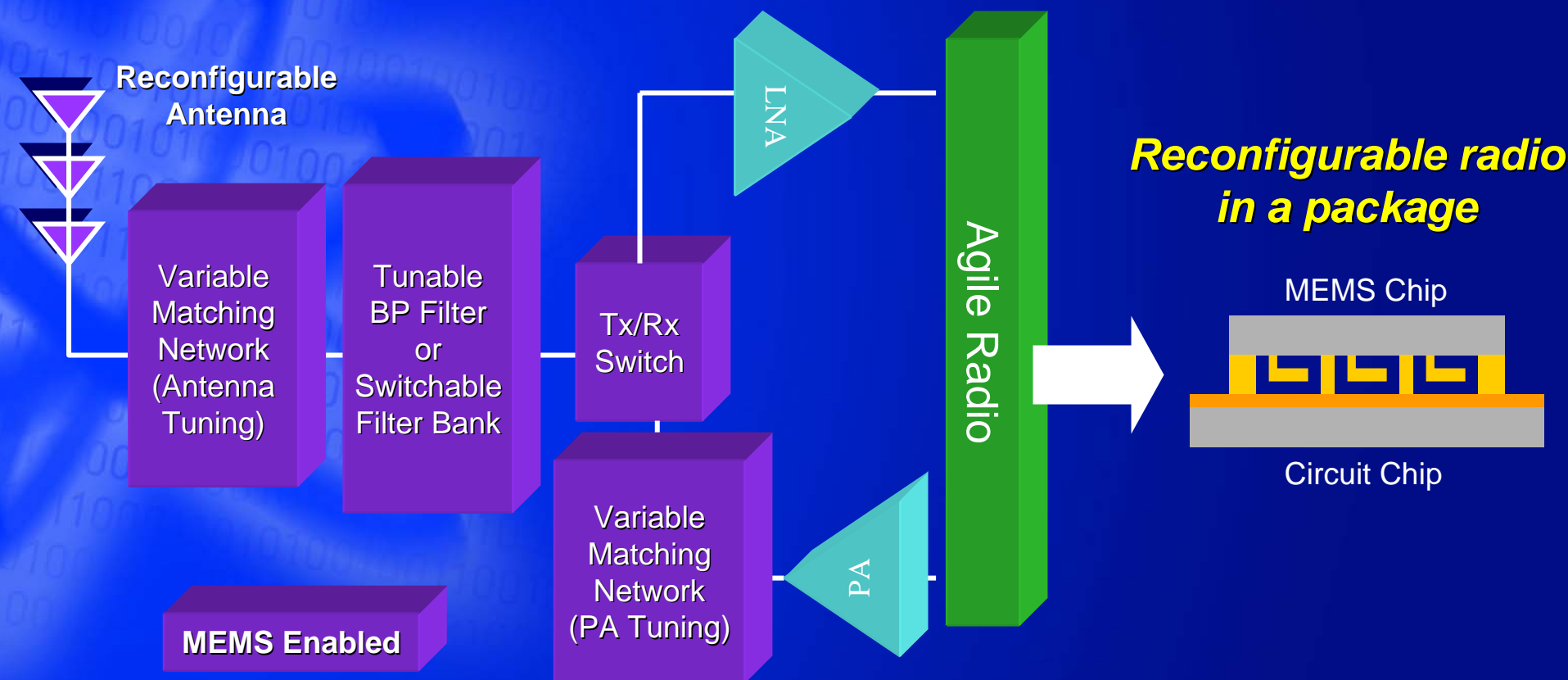
## Wireless Digital Picture Frame



# A Glimpse...

Patent #6,812,810

## Bridges for Electromechanical Structures

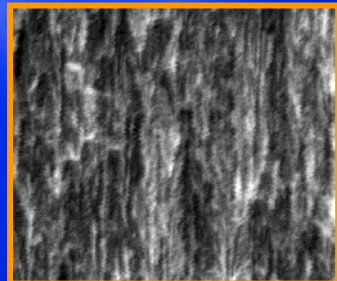
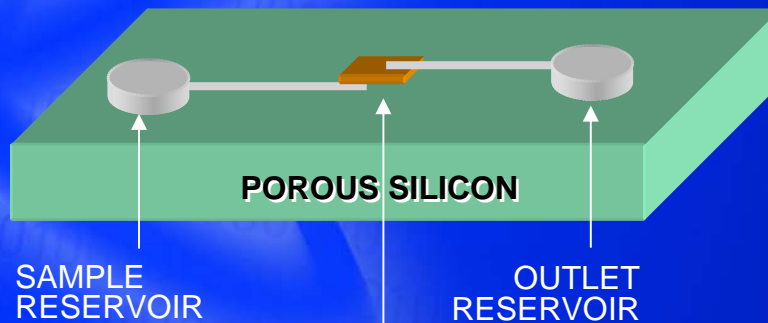
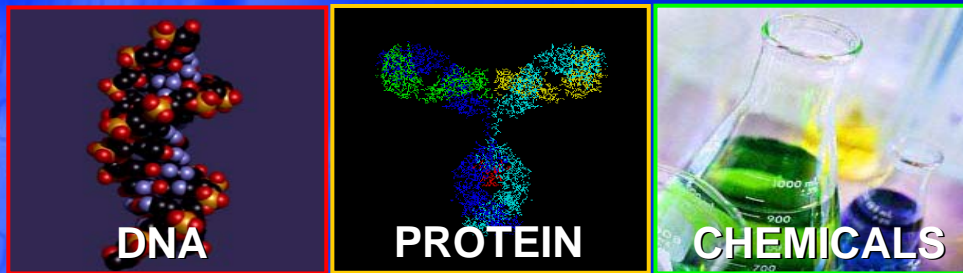




# A Glimpse...

Patent #6,806,543

## Microfluidic Apparatus with Integrated Porous-Substrate/Sensor for Real-time (Bio) Chemical Molecule Detection



- Microfluidic apparatus for detecting biological and chemical molecules and compounds
  - ♦ Includes integrated porous substrate/sensors
  - ♦ Porous membrane with sensing characteristics
- Optic-based detectors or electronic instrumentation to measure changes

# A Glimpse...

Patent #6,782,249

## Quadrature Signal Generation in an Integrated Direct Conversion Radio Receiver

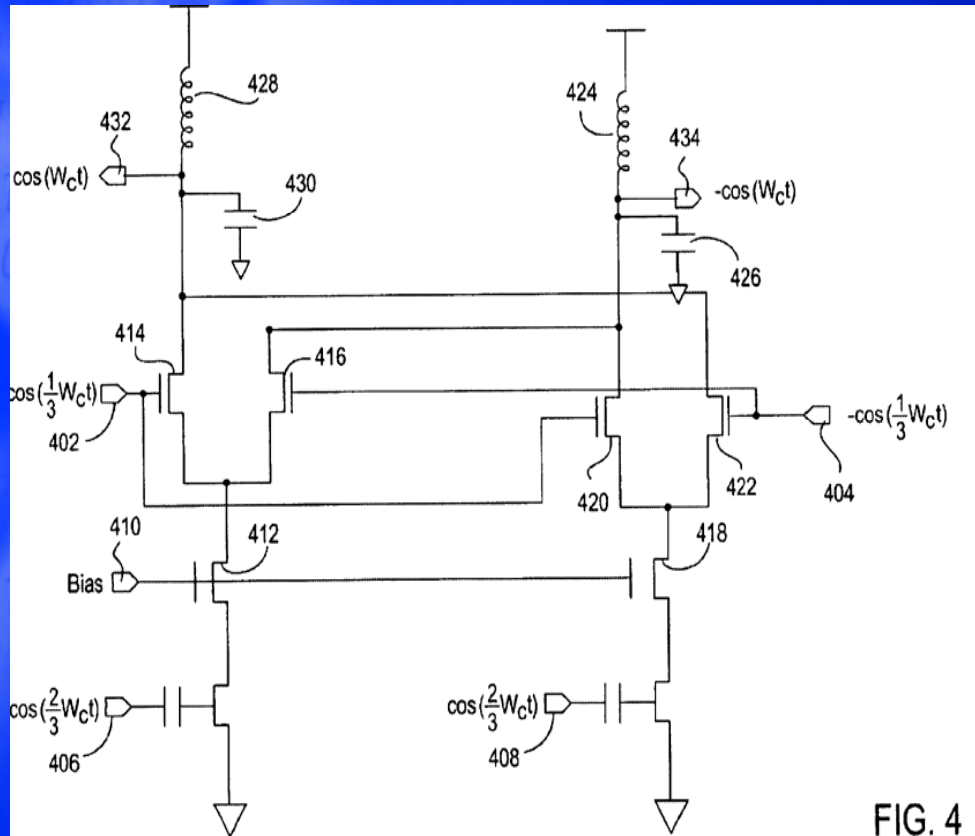


FIG. 4

A receiver for direct conversion of RF signals, a particular embodiment comprising a quadrature signal generation circuit having an oscillator with an oscillation frequency of  $\frac{2}{3}$  times that of the carrier frequency of the RF signal. For the particular embodiment, the quadrature generation circuit includes a divide-by-two division circuit to provide quadrature signals having a frequency of  $\frac{1}{3}$  that of the carrier frequency, and further including mixers and filters to mix the output of the oscillator and the output of the divide-by-two division circuit so as to provide quadrature signals at the carrier frequency.

# Biotech Patents

Pat. No.	Title	Inventors
6,610,605	Method and Apparatus for Fabricating Encapsulated Micro-Channels in a Substrate	Paul Winer Jeremy Rowlette
6,774,333	Method and System for Optically Sorting and/or Manipulating Carbon Nanotubes	Eric Hannah
6,749,733	Materials Classifier, Method of Using, and Method of Making	Scott Sibbett



# Intel's First Patent...

## United States Patent

[11] 3,631,313

[72] Inventor Gordon E. Moore  
Los Altos Hills, Calif.  
[21] Appl. No. 874,529  
[22] Filed Nov. 6, 1969  
[45] Patented Dec. 28, 1971  
[73] Assignee Intel Corporation  
Mountain View, Calif.

### OTHER REFERENCES

IBM Tech. Disc. Bull. Vol. 9, No. 2, pp. 195-196; Regh, "Fabrication of Two Surface Devices" July 66  
IBM Tech. Disc. Bull. Vol. 11, No. 8, p. 918; Wu, "Current Switch Emitter-Follower Connection" (Jan. 69)  
IBM Tech. Disc. Bull. Vol. 11, No. 11, p. 1390; Geller, "Semiconductor Device with Vertical Resistor," (April 1969)  
Seelbach et al., South African Patent Journal, July 1968, page 119; Application for "Voltage Distribution System for Integrated Circuits"

Primary Examiner—John W. Huckert  
Assistant Examiner—William D. Larkins  
Attorney—Spensley, Horn & Lubitz

### [54] RESISTOR FOR INTEGRATED CIRCUIT 9 Claims, 9 Drawing Figs.

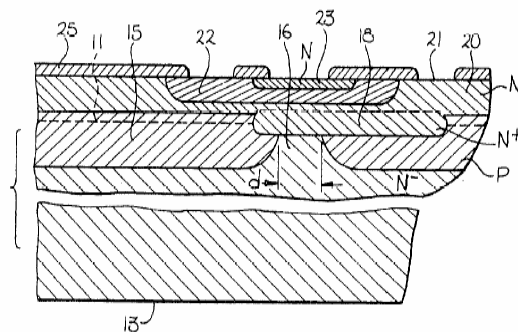
[52] U.S. Cl. 317/235, 317/235 D, 317/235 E, 317/235 AM  
[51] Int. Cl. H01L 19/00  
[50] Field of Search 307/303; 317/235 D, 235 E, 235 AM

### [56] References Cited

#### UNITED STATES PATENTS

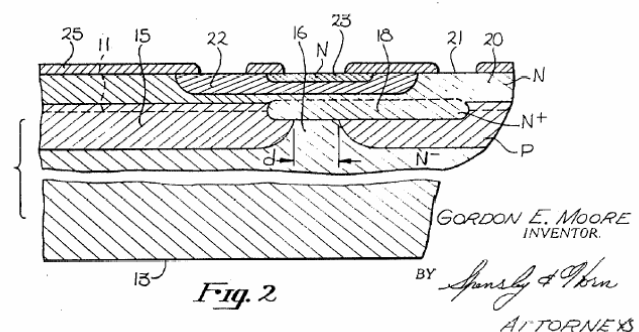
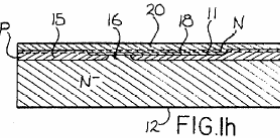
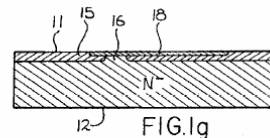
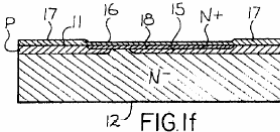
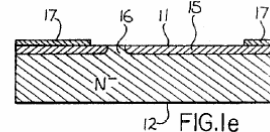
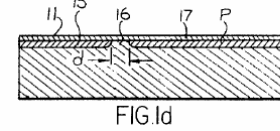
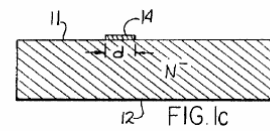
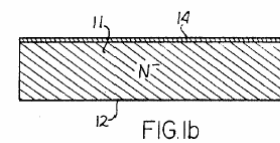
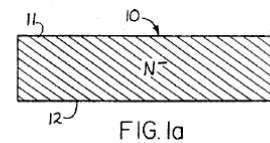
3,569,800	3/1971	Collins	317/235
3,573,573	4/1971	Moore	317/235
3,244,950	4/1966	Ferguson	317/235
3,253,197	5/1966	Haas	317/235
3,518,510	6/1970	Lamming	317/235

**ABSTRACT:** Electrical resistor of semiconductor material formed in the thickness dimension of a high-resistivity substrate underlying an epitaxial layer of the same conductivity-type. A region of the opposite conductivity-type in the substrate, contiguous with the epitaxial layer, extends laterally across all but a predetermined area of the substrate in conjunction with the resistivity of the substrate material determining the resistance value of the resistor. Semiconductor devices and other circuit elements may be formed in the epitaxial layer in accordance with known techniques, the resistor being in series with any desired ones of the additional elements.



PATENTED DEC 28 1971

3,631,313



# Tidbits: Intel's Early Patenting Activities

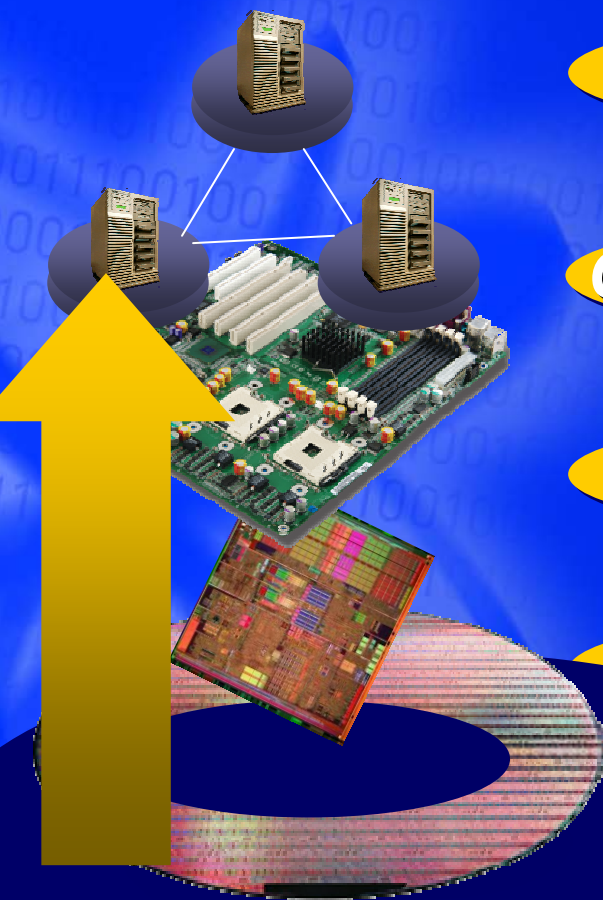
- Gordon Moore – Intel's first patent recipient
  - ♦ 3,631,313: Electric Resistor of Semiconductor Material
  - ♦ 3,825,442: Process for glass reflow which allowed metal to be placed on a glass layer without cracking occurring in the metal
- Ted Hoff was recognized by many as one of the fathers of the microprocessor
  - ♦ Ted's early innovations at Intel included a three-transistor cell (pat. 3,593,037) used in the earliest DRAM products: the 1103
- Integration of components onto a single chip were among Intel's earliest patents
  - ♦ 3,821,715: Memory System for a Multi-Digital Chip Computer which integrated address determination circuitry on MOS memory chips

***Nothing to do with Silicon....***

**5,859,636: Recognition of and Operation of Text Data**

Recognizes URL buried in a word document, and allows opening the web page specified by the URL

# Key Research Vectors



***Applications***

**Workloads**

Drivers, Compilers, Optimization  
Tools, Managed Runtimes, Open  
Source Libraries

***Communications***

**Radio and Wireless**

WAN/ LAN/ PAN Infrastructure  
Optical

***Platforms***

**Virtualization, Security/Trust**

Thermals and Mechanicals  
Interfaces  
Power Management

***Architecture***

**$\mu$ -arch, Multi-threading, Multi-core**

Memory/ Cache Hierarchies  
Interconnects  
Lo-Power Circuits, \*T's

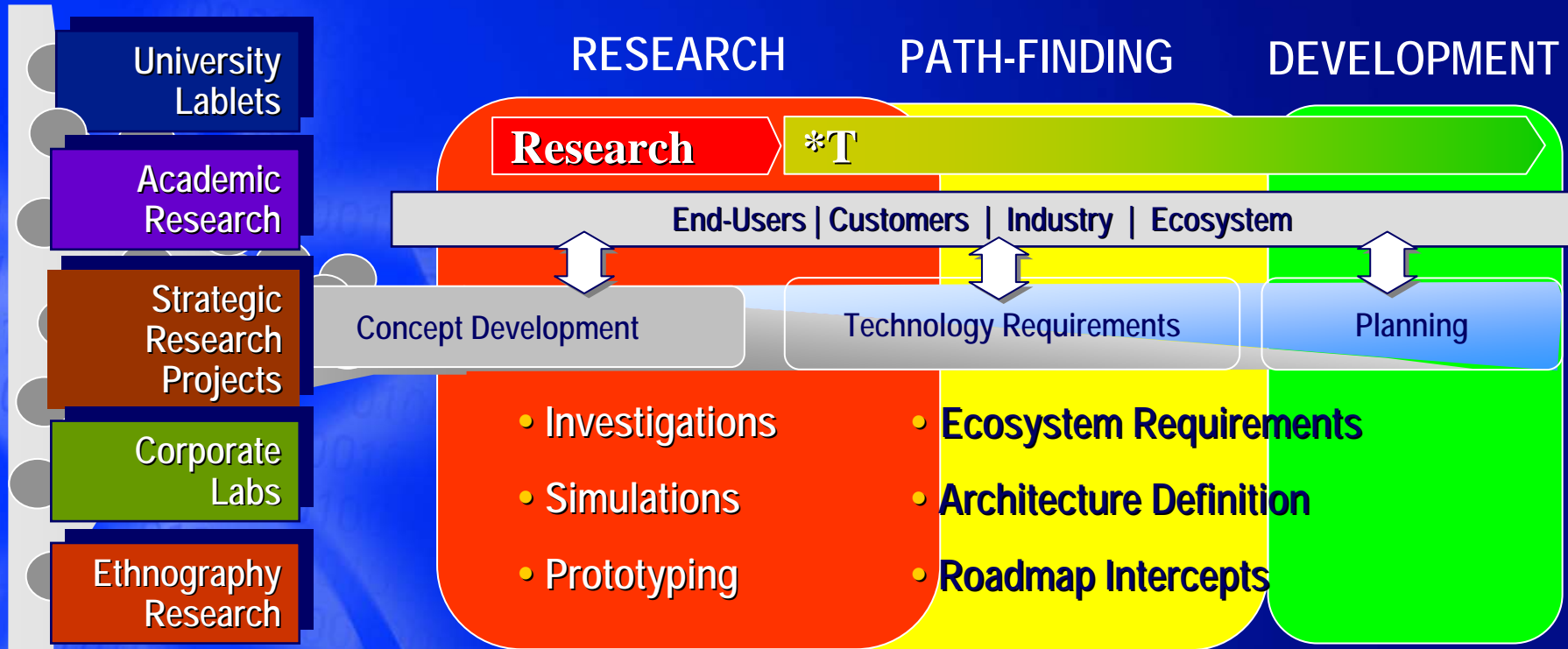
***Silicon***

**Moore's Law: 65nm, 45nm, ...**

**Devices & Materials: Tri-gate, Hi-Lo-K, ...**  
**Nano Assembly: Atomic Layer Deposition**



# Role of R&D: Path to a \*T



- Repeatable process that takes new ideas from research through technology readiness to product
- Touches end-users, customers, and ecosystem throughout

# Intel Labs



**Justin Rattner**  
Intel Senior Fellow and  
Director

Architectural  
Innovation



## *Computing Technologies*

### Focus Areas

- Advanced Circuits Research
- Power-optimized IA Cores
- New Microarchitectures for Thread-level Parallelism
- Streaming Media and Graphics Pipelines
- Extensible Architecture Research
- Programming Systems
- Managed Run-time Environments

# Intel Labs



**Raj Yavatkar**  
Intel Fellow  
and Director



**Raj Hazra**  
Director



- ♦ Integrated 802.11b and GSM/GPRS... GPS
- ♦ Mixed-network voice (GSM and VoIP)
- ♦ Mixed-network media (video w/GPRS to 802.11b roaming)
- ♦ Low-power OLED display and multimode keyboard

## *Systems Technologies*

### Focus Areas

- Handheld Manageability
- Low Power on Intel® Architecture
- Manageable Identities
- Universal Communicator
- Research Platforms
- Platform Technology Ingredients
- Interconnect Technologies and Standards
- Content Protection/DRM Technologies and Policy



# Intel Labs



Kevin Kahn  
Intel Senior Fellow  
and Director



Abel Weinrib  
Vice President  
and Director

## Wireless End-to-End



## *Communications and Network Technologies*

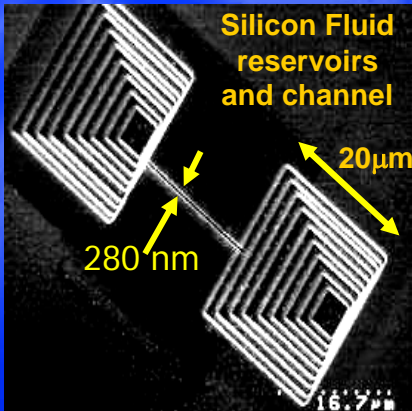
### Focus Areas

- Wireless End-to-End
  - CMOS Radio Components
  - Software-defined Radios
  - Smart Antenna Systems
  - Mobile Networked Systems
  - RF Technology and Air Interfaces
- Performance Networking
- Silicon Photonics
- Spectrum Policy and Regulatory Practices

# Intel Labs



**David Tennenhouse**  
**Director**



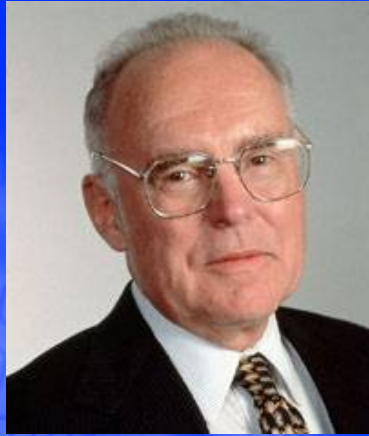
Creating a new generation of bio-instruments capable of operating in the *single-molecule* regime

## *Exploratory Research*

### Focus Areas

- Proactive Computing
  - Ubiquitous Computing
  - Machine Learning
  - Proactive Health
  - Precision Biology
- Ethnographic Research

# Intel Fellows Program



*“Intel Fellows exemplify the best of Intel, and their work is often a showcase of Intel Values. ...Fellows are typically experts in a technical area with numerous innovations, patents, publications, and a consistent history of technical leadership. They also provide coaching and mentoring in their areas of expertise.”*

**Gordon Moore,  
Intel co-founder**

- Allows outstanding technical contributors to progress in technical roles rather than managerial.
- Intel Fellows and Intel Senior Fellows represent the highest levels of technical achievement within the company.
- They are selected for their technical leadership and outstanding contributions to the company and the industry.
- Fellows are expected to have very strong input on Intel's technical direction.

# Efforts Beyond Silicon: Building the Ecosystem

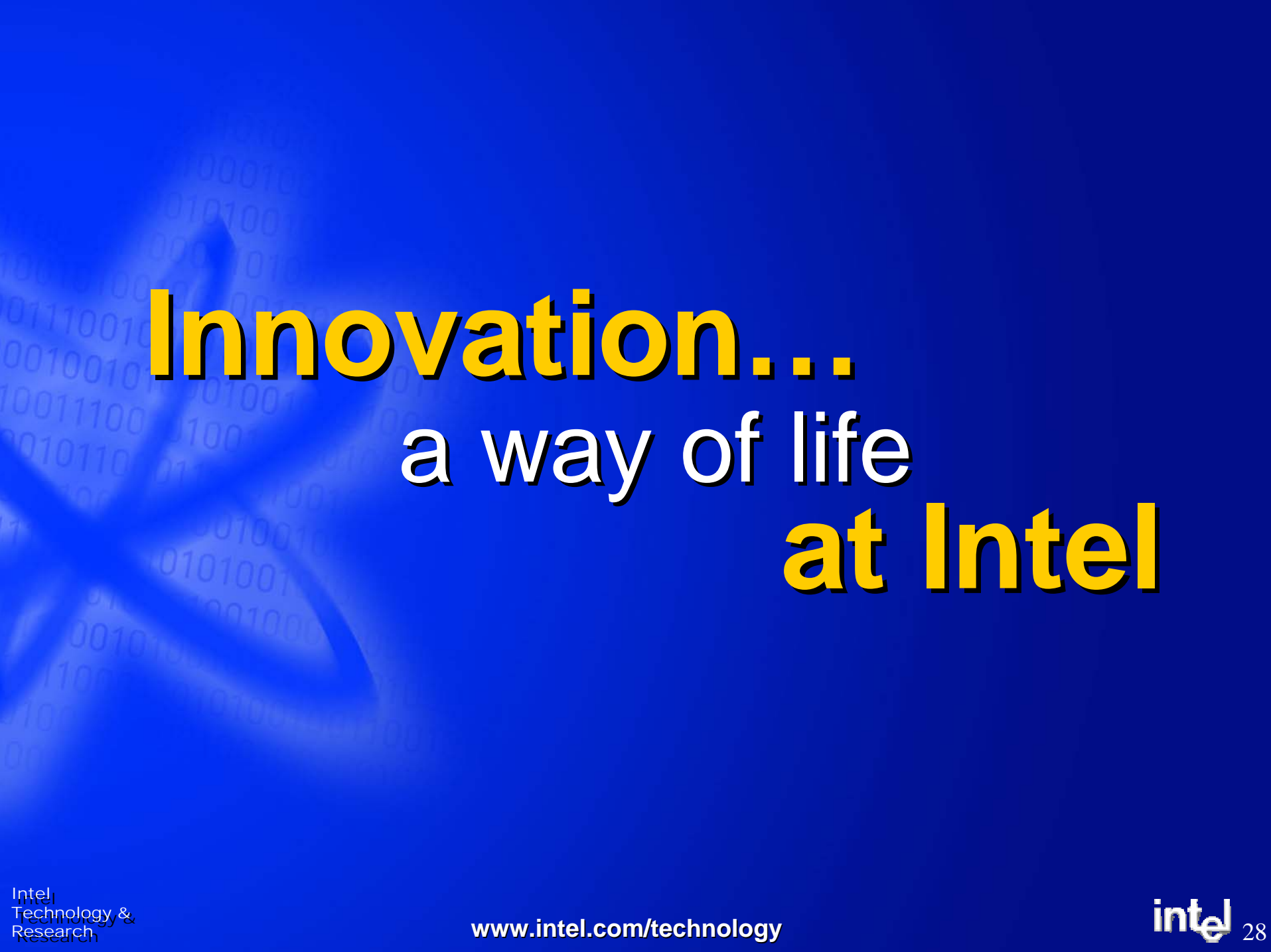


\*Other names and brands may be claimed as the property of others.

R&D, Investments, Software, Solutions

[www.intel.com/technology](http://www.intel.com/technology)





# Innovation...

a way of life  
at Intel